CERTIFICATION WITH THE SUBMITTAL OF SECURE LANDFILL FINAL DESIGN REPORT VOLUME III HYDROGEOLOGIC INVESTIGATION

All information contained in this document is to the best of our knowledge, factual and represents CDM's total understanding of the conditions and circumstances at the ALCOA facility and impacted area. The conclusions and recommendations contained in this document represent CDM's best professional engineering judgement on remediation that meets those applicable or relevant and appropriate requirements and represents sound engineering practices and principles to protect public health and the environment.

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REMEDIATION PROJECTS ORGANIZATION

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EXECUTIVE SUMMARY

In support of the preliminary design, a hydrogeologic investigation has been conducted at the secure landfill site. The goals of the investigation included gathering information for the evaluation of hydrogeologic conditions at the site in support of the landfill design and the design of a groundwater monitoring program.

The hydrogeologic investigation included the installation of 30 wells in the secure landfill area. The information gathered during well installation served as the basis for defining the stratigraphy and groundwater flow patterns in the area. The results of the hydrogeologic conditions at the secure landfill site can be summarized as follows:

- The landfill site is on top of a till ridge which rises to approximately 260 feet MSL. The ridge is comprised of three till units including the Fort Covington Upper Till, Malone Middle Till, and Malone Lower Till. The depth to bedrock on the ridge averages over 100 feet.

- The till units in the area are generally classified as dense to very dense silt till. In general, the hydraulic conductivity in the till decreases with depth. The average horizontal hydraulic conductivities in the upper and middle till are approximately 10^{-5} to 10^{-6} cm/sec. The average horizontal hydraulic conductivity in the lower till is approximately 10^{-7} cm/sec. The estimated vertical hydraulic conductivities of the till units are one to two orders of magnitude lower than the horizontal hydraulic conductivities. Horizontal hydraulic conductivities in bedrock wells varied. However, on average, the bedrock hydraulic conductivity is estimated to be 10^{-4} to 10^{-3} cm/sec.

- There were no laterally-extensive, continuous layers or lenses of higher hydraulic conductivities observed within the till units on the ridge. However, the upper 15 feet of Fort Covington till on the ridge is fractured and weathered and this zone has a higher hydraulic conductivity than the unaltered till.

- Because of the low hydraulic conductivity in the till, it does not yield groundwater in sufficient quantities to be used for supply. However, the bedrock aquifer is currently used for supply in the area. The secure landfill site provides excellent protection for the bedrock aquifer because of the significant thickness of low permeability till between the landfill and bedrock. The Malone Lower Till is a particularly effective barrier to groundwater flow from the till to bedrock.

A three-dimensional numerical groundwater model was developed based on the information gathered during the hydrogeologic investigation. Groundwater modeling was conducted primarily to confirm the understanding of hydrogeologic conditions, to predict the amount of water table lowering following landfill construction, and to simulate plume migration from hypothetical leaks from the landfill to assist in the design of the groundwater monitoring network. The results of the groundwater modeling can be summarized as follows:

- Groundwater modeling confirmed the very low hydraulic conductivities in the till, particularly the Malone Lower Till. The groundwater model showed that horizontal flow predominates in the till on the ridge, with very little recharge reaching the bedrock aquifer, or less than 1% of the effective recharge. The estimated travel times through the till to bedrock (on the ridge) are on the order of 1000 years.

- The amount of average water table lowering on the ridge below the landfill following construction is predicted to be 2 to 8 feet below current levels. However, it is predicted that the water levels will take approximately 40 years to reach 90% of the equilibrium levels, and about 10 to 15 years to reach 50%.

- Simulations of plumes emanating from hypothetical leaks from the landfill showed very little migration or dispersion in either the horizontal or vertical direction after many years. It is estimated that it would take approximately 30 years for a potential leak to reach the monitoring network. This is primarily because of the very slow groundwater travel times.

The landfill has been designed to maintain a minimum five-foot separation between the bottom of the lowermost liner and the seasonal high water table, per the requirements of the Part 360 regulations. The water table was defined using the August, 1992 set of water level measurements, because landfill construction is likely to result in partial dewatering of the surficial till layer, similar to the water level decline that occurs naturally during the summer and fall seasons. Landfill construction will also cause a permanent reduction in effective recharge, primarily due to the impervious landfill liner system, but also from increased runoff from previously-vegetated areas and from dewatering for soil borrow operations. The net effect of the landfill on the water table is therefore expected to be an initial, partial dewatering associated with construction activities, a permanent suppression of the natural seasonal variations, and a slow decline in the average water table below the landfill because of complete blockage of recharge there.

The separation between the lowermost landfill liner and the water table already meets or exceeds five feet throughout landfill cells 1 and 2, and most of cell 3, using the August, 1992 water level information. The southeastern extent of cell 3, and most of cell 4, have bottom-of-liner elevations that will be over five feet from the water table following the construction activities and the water table decline that will occur after the liners cut off all rainfall infiltration. Groundwater levels will be monitored frequently, especially during the landfill construction and initial operation period, to ensure that sufficient water table separation distances are maintained. Should the water table remain at an elevation that is within the five-foot separation distance, during two successive spring seasons, then permanent drainage controls will be installed to lower the water table sufficiently. This would likely consist of a french drain running along the

southeastern corner of the landfill, to intercept groundwater flow from the upgradient till ridge area.

The seasonal variation in the water table will be monitored by measuring water levels in key wells and piezometers surrounding the landfill. The observed seasonal variations in the till's water table are typically from two to five feet. Monitoring of early spring water levels is critical to defining the seasonal high water table, and so the most complete round of water level measurements will be taken during that season. Water level monitoring will continue through the baseline, pre-construction period and into the construction and filling phases, to ensure the collection of adequate data for evaluating the seasonal high water table and the liner separation distance.

An initial assessment of groundwater quality in the secure landfill area showed that groundwater generally reflects typical regional quality and has not been significantly affected by nearby waste disposal sites. However, degradation in groundwater quality has been observed in both overburden and bedrock wells within 1000 feet of the landfill area at various waste disposal sites. Therefore, migration of contamination from disposal areas toward the landfill is possible. The potential for groundwater contamination originating at disposal areas and entering the landfill area is greatest in the bedrock, where groundwater velocities may be higher than in the overburden strata in general.

A proposed groundwater monitoring program was designed based on 6 NYCRR Part 373, Part 360, and TSCA regulations and the information gathered during the hydrogeologic investigation. The strategy for the groundwater monitoring program can be summarized as follows:

- The bedrock aquifer constitutes the shallowest aquifer below the landfill and therefore must be monitored in accordance with Part 373 regulations. Semi-annual monitoring for indicator parameters in bedrock upgradient and downgradient from the landfill is proposed.

- Although bedrock monitoring is required to ensure groundwater quality changes that would possible threaten downgradient users are not occurring, monitoring in bedrock is not a suitable means for detection of potential leaks from the landfill because of the dense till overburden. Therefore, monitoring in the saturated overburden is also proposed as the final component in the detection monitoring program, which includes the evaluation of leachate quantity in the two liner systems to ensure the liners are functioning properly. Overburden groundwater wells are located 300-500 feet apart downgradient, which is consistent with Part 360 regulations. Upgradient overburden monitoring is also proposed with the well spacing meeting the Part 360 guidelines. Shallow overburden wells will be monitored semiannually. The middle overburden wells will be monitored annually.

- Prior to the placement of fill in the landfill and the initiation of groundwater monitoring, a complete evaluation of baseline groundwater quality will be made, which will include four rounds of quarterly monitoring.

- Indicator parameters for groundwater monitoring are proposed, based on the expected quality of leachate in the secure landfill. The set of indicator parameters proposed includes VOCs, PCBs, metals, and several conventional (inorganic) parameters. This list of parameters is consistent with the Part 360 routine and baseline parameters for water quality monitoring. Modification of this list would be considered should the actual quality of the leachate vary or if there is an indication of a potential leak from the landfill.

- The proposed groundwater monitoring program is consistent with the applicable Part 373 and Part 360 regulations as well as the hydrogeologic conditions at the secure landfill site. It provides a means for evaluation of groundwater quality in the bedrock aquifer and provides the final component of the leak detection program which includes the leachate monitoring and controls associated with landfill operation, as described in the landfill engineering design report.

The current landfill design and monitoring program may require two waivers from TSCA technical requirements for chemical waste landfills (40 CFR 761.75(b). The landfill will not be 50 feet from the water table as required by TSCA. However, the landfill will be more than 50 feet above the shallowest aquifer (in this case bedrock) used for potable supply in the area. Also, the landfill groundwater monitoring program does not include monitoring for all EPA chlorinated organics as specified in 40 CFR 761.75. The current list of parameters is based on the expected quality of the wastes and leachate generated. Some chlorinated organics are included in the volatile organic analysis. Groundwater will also be monitored for PCBs.